Nut Rotary Actuator
NS Series

[LXMS, LXMM, LXMXS, LZMS, LZMM]

Operating Manual

First Edition

IAI
Quality and Innovation

IAI America, Inc.

Safety Precautions (Please Read Before Use)

Before installing, operating, maintaining or inspecting this product, peruse this operating manual as well as operating manuals and related documentations for all equipment and peripherals connected to this product to ensure the correct use of the product. Also keep in mind that these tasks must be performed by individuals who possess sufficient knowledge of the applicable equipment and safe operation thereof. The precautions provided below are intended to prevent bodily injury and/or property damage by making sure the product is used correctly and safely.

In this operating manual, safety precautions are classified as “danger,” “warning,” “caution” and “note.”

⚠ Danger	Failure to observe the instruction will result in an imminent danger leading to death or serious injury.
⚠ Warning	Failure to observe the instruction may result in death or serious injury.
⚠ Caution	Failure to observe the instruction may result in injury or property damage.
ⓘ Note	The user should take heed of this information to ensure the proper use of the product, although failure to do so will not result in injury.

Take note that, depending on the situation, a failure to heed the directions accompanied by ⚠ Caution or ⓘ Note may still result in serious consequences.
All instructions provide important information. Read them carefully and handle the product with due care.
Keep this operating manual in a convenient place so that it can be readily referenced whenever necessary, and also make sure the manual gets to the hands of the end-users.

⚠ Danger

[General]

- Do not use this product for the following applications:
  1. Medical equipment used to maintain, control or otherwise affect human life or physical health
  2. Mechanisms and machinery designed for the purpose of moving or transporting people
  3. Important safety parts of machinery

This product has not been planned or designed for applications requiring high levels of safety. Use of this product in such applications may jeopardize the safety of human life. The warranty covers only the product as it is delivered.

[Installation]

- Do not use this product in a place exposed to ignitable, inflammable or explosive substances. The product may ignite, burn or explode.
- When installing the product, be sure to securely support and affix it (including the work). Failure to do so may cause the product to tip over, drop or malfunction, resulting in injury.

- Avoid using the product in a place where the main unit or controller may come in contact with water or oil droplets.
- Never cut and/or reconnect the cables supplied with the product for the purpose of extending or shortening the cable length. Doing so may result in fire.

[Operation]

- Do not enter the machine's range of operation while the product is operating or standing by. The actuator may move suddenly, causing injury.
- Do not pour water onto the product. Spraying water over the product, washing it with water or using it in water may cause the product to malfunction, resulting in injury, electric shock, fire, etc.

[Maintenance, Inspection, Repair]

- Never modify the product. Unauthorized modification may cause the product to malfunction, resulting in injury, electric shock, fire, etc.
- Do not disassemble and reassemble the components relating to the basic structure of the product or its performance and function. Doing so may result in injury, electric shock, fire, etc.

⚠ Warning

[General]

- Do not use the product outside the specifications. Using the product outside the specifications may cause it to fail, stop functioning or sustain damage. It may also significantly reduce the service life of the product. In particular, observe the maximum loading capacity and speed.

[Installation]

- If the machine will stop in the case of system problem such as emergency stop or power failure, design a safety circuit or other device that will prevent equipment damage or injury.
- Before supplying power to and operating the product, always check the operation area of the equipment to ensure safety. Supplying power to the product carelessly may cause electric shock or injury due to contact with the moving parts.
- Wire the product correctly by referring to the operation manual. Securely connect the cables and connectors so that they will not be disconnected or come loose. Failure to do so may cause the product to malfunction or cause fire.

[Operation]

- Before operating the moving parts of the product by hand (for the purpose of manual positioning, etc.), confirm that the servo is turned off (using the teaching pendant). Failure to observe this instruction may result in injury.
- Do not scratch the cables. Scratching, forcibly bending, pulling, winding, crushing with heavy object or pinching a cable may cause it to leak current or lose continuity, resulting in fire, electric shock, malfunction, etc.
- Turn off the power to the product in the event of power failure. Failure to do so may cause the product to suddenly start moving when the power is restored, thus resulting in injury or product damage.
- If the product is generating heat, smoke or a strange smell, turn off the power immediately. Continuing to use the product may result in product damage or fire.
- If noise or abnormally high vibration is detected, stop the operation immediately. Continuing to use the product may result in product damage, malfunction due to damage, runaway machine, etc.

- If any of the internal protective devices (alarms) of the product has actuated, turn off the power immediately. Continuing to use the product may result in product damage or injury due to malfunction. Once the power supply is cut off, investigate and remove the cause and then turn on the power again.
- Do not step on the product, use it as a footstool or place any object on it. You may lose your footing or the product may tip over, resulting in a fall and consequent injury, product damage, malfunction due to damage, runaway machine, etc.

[Maintenance, Inspection, Repair]

- Before conducting maintenance/inspection, parts replacement or other operations on the product, completely shut down the power supply. At this time, take the following measures:
  1. Display a sign that reads, “WORK IN PROGRESS. DO NOT TURN ON POWER” at a conspicuous place, in order to prevent a person other than the operator from accidentally turning on the power while the operation is working.
  2. When two or more operators are to perform maintenance/inspection together, always call out every time the power is turned on/off or an axis is moved in order to ensure safety.

[Disposal]

- Do not throw the product into fire. The product may burst or generate toxic gases.

⚠ Caution

[Installation]

- Do not use the product under direct sunlight (ultraviolet ray), in a place exposed to dust, salt or iron powder, in a humid place, or in an atmosphere of organic solvent, phosphate-ester machine oil, etc. The product may lose its function over a short period of time, or exhibit a sudden drop in performance or its service life may be significantly reduced.
- Do not use the product in an atmosphere of corrosive gases (sulfuric acid or hydrochloric acid). Rust may form and reduce the structural strength of the product.
- When using the product in any of the places specified below, provide a sufficient shield. Failure to do so may result in malfunction:
  1. Place where large current or high magnetic field is present
  2. Place where welding or other operations are performed that cause arc discharge
  3. Place subject to electrostatic noise
  4. Place with potential exposure to radiation
- Do not install this product in places where the product may receive vibration or shock.
- Provide an emergency-stop device in a readily accessible position so the device can be actuated immediately upon occurrence of a dangerous situation during operation. Lack of such device in an appropriate position may result in injury.
- Provide sufficient maintenance space when installing the product. Routine inspection and maintenance cannot be performed without sufficient space, which will eventually cause the equipment to stop or the product to sustain damage.
- When transporting or installing the product, exercise due caution to prevent injury. For example, securely hold the product using a lift or support or engage multiple operators to carry the product.
- Do not hold the moving parts of the product or its cables during installation. It may result in injury.
- Always use IAI’s genuine cables for connection between the controller and the actuator. Also use IAI’s genuine products for the key component units such as the actuator, controller and teaching pendant.
- Do not use the brake mechanism as a safety brake, etc.
- Before installing or adjusting the product or performing other operations on the product, display a sign that reads, “WORK IN PROGRESS. DO NOT TURN ON POWER.” If the power is turned on inadvertently, injury may result due to electric shock or sudden activation of an actuator.

[Operation]

- Turn on the power to individual equipment one by one, starting from the equipment at the highest level in the system hierarchy. Failure to do so may cause the product to start suddenly, resulting in injury or product damage.
- Do not insert a finger or object in the openings in the product. It may cause fire, electric shock or injury.
- Do not step on the product, use it as a footstool or place any object on it. It may cause scoring, dents or deformation of the driving part, resulting in product damage, unintended stopping due to damage, or performance drop.

[Maintenance, Inspection, Repair]

- Wear protective goggles when applying grease to the actuator. Failure to do so may result in eye inflammation due to spattered grease.

Note

[Installation]

- Protection covers or other guards must be provided for the moving parts of the equipment to avoid direct contact with the operators.
- Do not configure a control circuit that will cause the work to drop in case of power failure. Configure a control circuit that will prevent the table or work from dropping when the power to the machine is cut off or an emergency stop is actuated.
- Take the following precautions to increase the linear traveling accuracy of the table and ensure smooth movement of the ball screw and linear guide:
  1. Flatness of the mounting surface must be within 0.05 mm.
  2. The mounting surface area must be large enough to ensure the rigidity of the actuator.

[Installation, Operation, Maintenance]

- When handling the product, wear protective gloves, protective goggles, safety shoes or other necessary gear to ensure safety.

[Maintenance, Inspection, Repair]

- To grease the guide and ball screw during maintenance, use the specified grease. In particular, do not mix fluorine grease and lithium grease, as it may cause insufficient lubrication, higher resistance or other unwanted outcomes and ultimately damage the machine.

[Disposal]

- When the product becomes no longer usable or necessary, dispose of it properly as an industrial waste.

Others

■ IAI shall not be liable whatsoever for any loss or damage arising from a failure to observe the items specified in “Safety Precautions.”

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1. Foreword

Thank you for purchasing an IAI product.
This manual explains the structure, correct operation and maintenance of the actuator.
Please read this manual carefully before using the actuator. Keep this manual so that the necessary sections can be referenced whenever necessary.
For more complete operational information, please refer to the controller's operating manual.

2. Overview

This actuator adopts a nut rotary method to achieve high-speed transfer action.

3. Safety Precautions

3.1 Basic Operating Instructions

- Please do not attempt to use or operate the actuator in any manner not indicated in this manual or the controller manual.
- Please be sure to use only the cable provided by IAI to connect the actuator and controller.
- Please do not allow people within the moving range of the unit when it is in operation or when the power is ON since this is dangerous.

3.2 Maintenance and Inspection

- When doing maintenance and inspection work, always shut down the controller power first.
- When doing inspection, make sure that no one can inadvertently turn the power ON.
- When carrying out maintenance/inspection, put up a sign saying "Work in Progress" in a conspicuous location.
- If several persons are working, be sure to watch out for each other's safety. In particular, check before turning power ON or OFF and let others know if you are doing work involving axis movement.

(Notes)

- The contents of this manual are subject to change without notice for the purposes of improvement.
- This manual has been written with the utmost attention to accuracy. However, it is possible that the manual may still contain technical inaccuracies or typographical or other errors. Should you come across any inaccuracy or if you have any feedback regarding this manual, please contact IAI.

4. Warranty

4.1 Warranty Period

The warranty period corresponds to one of the following periods, whichever elapses first:

- 18 months after the shipment from IAI
- 12 months after the delivery to the specified location
- 2,500 hours of operation

4.2 Scope of Warranty

All defects in materials or craftsmanship found during the warranty period specified above will be repaired free of charge. Note, however, that the following items are excluded from the scope of this warranty:

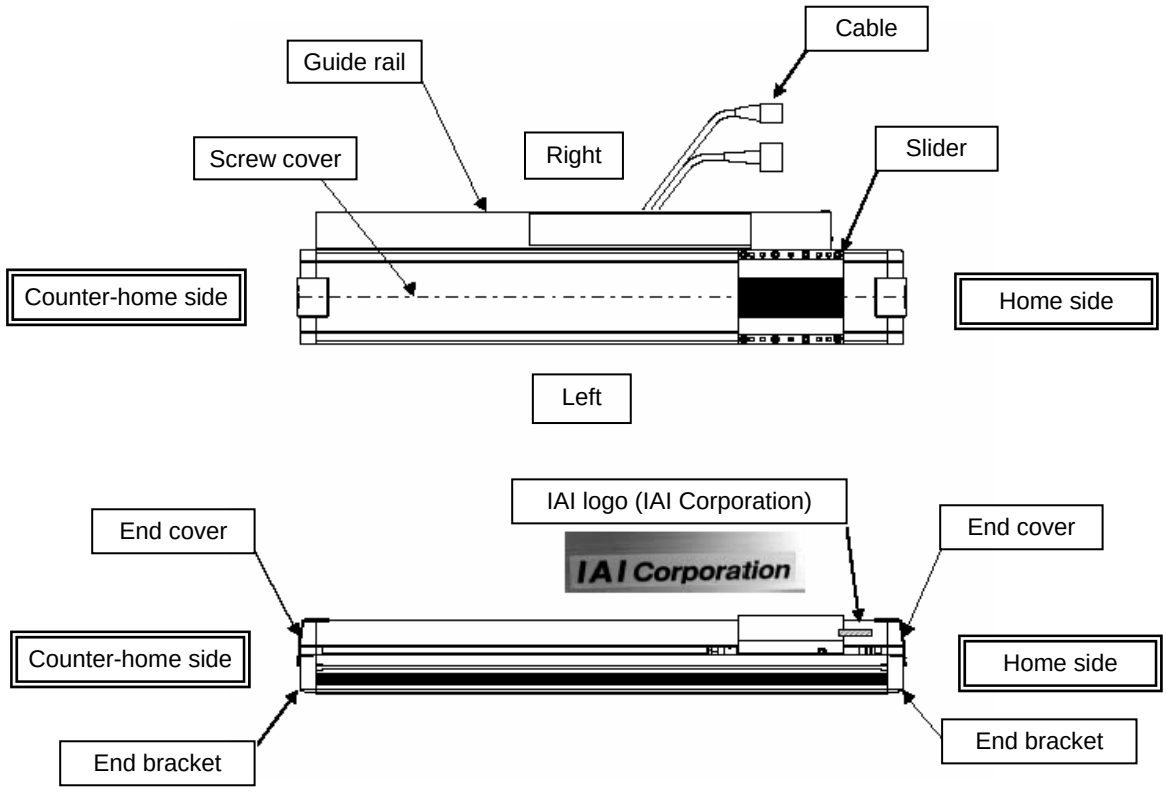
- Natural fading of exterior paint and other changes due to aging
- Wear of consumable parts from use
- Noises and other subjective conditions that do not affect function
- Inappropriate handling by the user or failure to conduct maintenance/inspection
- Modification not performed by IAI or its authorized dealer
- Breakdown resulting from using a controller not manufactured by IAI
- Anything caused by an act of God, accident, fire, etc.

This warranty covers only the product delivered. IAI shall not be liable for any secondary loss or damage arising from a defect in the product. To enjoy free warranty repairs, the customer must bring the defective product to IAI's factory.
Should you require an onsite repair by our engineer, separate fees will be chargeable even during the warranty period.

5. Names of the Parts

The names of the actuator parts are indicated below.

In this manual, the left and right sides are indicated by looking at the horizontally positioned actuator from the home side in top view. The front side corresponds to the counter-home side.
(Note) On an actuator of single-slider specification, the home side corresponds to the side where the IAI logo is shown.



*** The installation direction of the cable bearer varies depending on the specification of the delivered product.**

6. Transporting and Handling

6.1 Handling the Unassembled Actuator

6.1.1 Handling the Packed Unit

Unless otherwise specified, each single-axis actuator is packed and shipped individually. When transporting the packed actuator, exercise due caution to avoid dropping the box or hitting it against an object, structure, etc.

- Heavy shipping boxes should be carried by two or more persons.
- If the shipping box is left standing, it should be in a horizontal position.
- Do not climb on top of the shipping box.
- Do not place heavy objects on top of the shipping box.

6.1.2 Handling the Actuator After It is Unpacked

When handling the unpacked actuator, always hold the base.

- When carrying the actuator, exercise care not to hit it against an object, structure, etc. Pay particular attention to the end bracket, end cover and guide rail.
- Do not exert an excessive force on any part of the actuator. Pay particular attention to the screw cover and cables.

Supplement) Refer to 5, “Names of the Parts” for the name of each actuator part.

6.2 Handling the Assembled Actuator

Take heed of the following precautions when transporting the actuator after each axis has been assembled.

6.2.1 Preassembled Actuator

If specified, IAI assembles the mechanical components at our factory, conducts a shipping inspection on the assembly, and ships the assembled actuator by packing it with skid plates bolted to the exterior frame. The slider is secured to prevent sudden movement during transport. If the actuator is of combination type, the extremities are also secured to prevent excessive swinging caused by external vibration.

- The above packing specification does not reflect special considerations for protection against impact resulting from dropping or bumping the box. Handle the box carefully. The outer frame is not designed to withstand loads from the above, so do not place heavy objects on the frame.
- If the box is suspended using ropes, etc., pass the ropes around the reinforcement frame at the bottom face of skid plates. Similarly when lifting the actuator with a forklift, place the forks below the skid plates.
- Set down the box carefully to prevent application of impact or bouncing of the box upon landing.

◆ Once the actuator is unpacked, handle the actuator by observing the instructions below.

6.2.2 Handling the Actuator Assembled with Peripherals

When transporting the unpacked machine preassembled at IAI or customer-assembled machine, take heed of the following handling precautions:

- Secure the slider to prevent sudden movement during transport.
- If the actuator has any overhung extremity, properly secure the extremity to prevent excessive swinging caused by external force.
- If the actuator must be transported with its extremities not secured, make sure the actuator does not receive impact loads greater than 0.3 G.
- When suspending the actuator/peripherals using ropes, etc., do not allow the ropes to contact the actuator directly.
- When passing ropes, guide them around the base by inserting an appropriate buffer material between the rope and base.
- Support the tip of the Y-axis using a separate rope so that the axis will remain stable in a horizontal position. When roping the axis tip, exercise caution not to exert a load on the screw cover.
- Exercise caution not to apply loads on the brackets, covers and connector box. Also protect the cables against pinching or excessive deformation.

7. Operating and Storage Environment

7.1 Operating Environment

The actuator should be set up in an environment which meets the following criteria:

- Avoid direct sunlight.
- Avoid radiant heat from strong heat sources such as a furnace.
- Ambient temperature should be 0 ~ 40°C.
- The humidity should be less than 85% and there should be no condensation.
- Avoid exposure to corrosive or combustible gases.
- The area should have very little dust and be suitable for normal assembly operations.
- Avoid exposure to oil mist or fluids using in cutting.
- The actuator should not be subject to vibration or shock.
- The actuator should not be subject to significant levels of electromagnetic waves, ultraviolet rays or radiation.
- This product is not designed for use in a chemical environment.
  In general, the environment should be one in which an operator can work without protective gear.

7.2 Storage Environment

The storage environment should be similar to the operating environment. In addition, you must take precautions against condensation if the unit is to be stored for a long period of time. Unless there are special instructions, we do not include moisture absorption agents when shipping the unit. If you are storing the unit where condensation might occur, then you must treat the entire package or treat the unit itself after it is unpacked to prevent condensation. The unit can withstand up to 60°C during a short storage interval but only up to 50°C if the storage period is longer than one month.

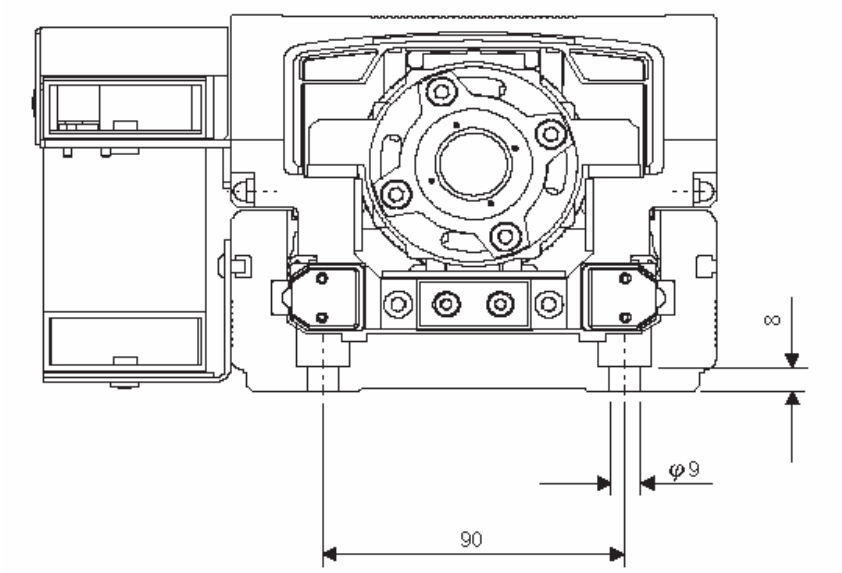
8. Installation

How to install the actuator is explained based on a single-axis configuration.

8.1 Installing the Main Body

The surface on which to install the actuator shall be a machined surface or a flat surface having equivalent accuracy.

- Mounting holes are provided in the actuator base, so use these holes to install the actuator. Use M8 bolts conforming to strength category 10.9 or above, together with the dedicated washers that came with the actuator (to prevent buckling).

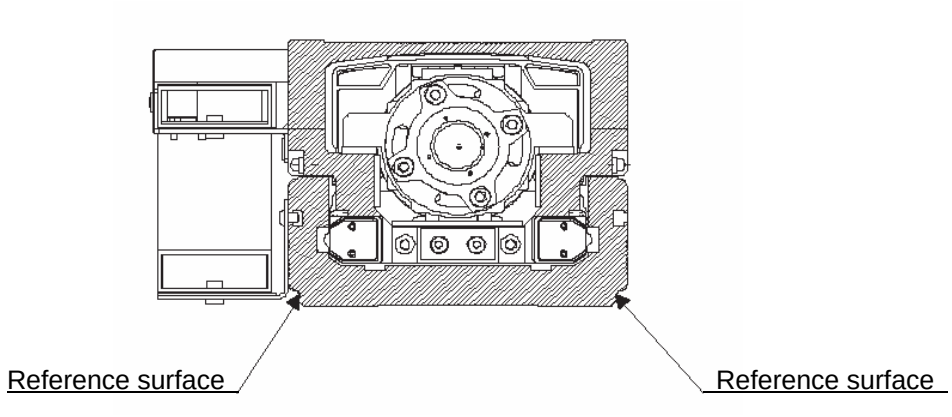


Applicable bolt	Remarks
M8	Use the dedicated washer.

- On an actuator of single-slider specification, the home is located on the end where the IAI log is attached on the side face of the screw cover. Pay attention to the direction when installing the actuator.

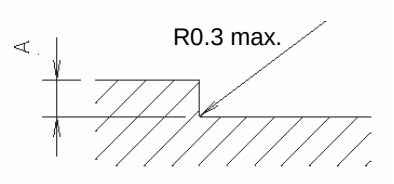
8.2 Installation Surface

- The frame shall have sufficient structural rigidity to prevent vibration.
- The surface on which to install the actuator shall be a machined surface or a flat surface having equivalent accuracy, where the surface flatness shall be within ±0.05 mm.
- Provide the space needed to carry out maintenance work.
- The side and bottom faces of the actuator base are used as reference surfaces for slider travel alignment.
- If high traveling accuracy is required, install the actuator using these surfaces as a reference.



As shown above, the side faces of the base are used as reference surfaces for slider travel alignment. If high traveling accuracy is required, install the actuator using these surfaces as a reference.

When installing the actuator on a frame using the reference surfaces of the base, provide the required machining by following the figure below.
When machining the surface, provide a margin corresponding to the thickness of the cover to prevent the ends of the actuator from contacting the front cover and rear cover.



Dimension A (mm)
3 ~ 5

8.3 Tightening Screws

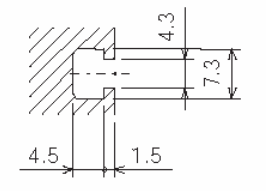
- Use hexagonal socket head bolts as the male threads with which to install the actuator base.
- Use of high-strength bolts conforming to ISO 10.9 or above is recommended.
- The effective engagement length between the bolt and female thread shall be at least the value specified below:
  When the female thread is made of steel → Same as the nominal diameter
  When the female thread is made of aluminum → Twice the nominal diameter
- If the bolt bearing surface is made of aluminum, also use a dedicated washer for high-strength bolt. (If the bolt is applied without an appropriate washer, the bearing surface may buckle.)

The recommended tightening torque is specified below.

Nominal thread size	Tightening torque	
	Steel bolt bearing surface	Aluminum bolt bearing surface
M8	31.3 N·m (3.19 kgf·m)	14 N·m (1.43 kgf·m)

8.4 Mounting T-slot

A M4 T-groove is provided in each side face of the base for installing a connector box, cable bearer catch or any other necessary component. (Refer to the figure below.)
If the combined specification requires a wiring kit, use this T-slot to install the kit.
The T-slot can also be used to install sensors or secure wires or for various other purposes as deemed necessary.

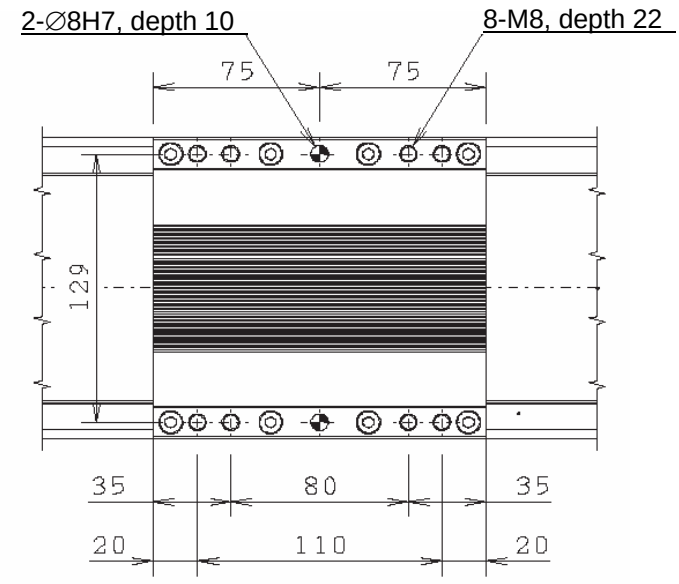


Caution:
- Although square nuts are recommended, general hexagonal nuts can also be used with the T-slot.
- When installing a bolt in the T-slot, pay attention to the bolt length to make sure the tip of the bolt will not contact the bottom of the T-slot.

8.5 Installing a Load on the Slider

- Tapped holes are provided in the slider, so use these holes to securely affix a load.
  The affixing method varies depending on how the actuator is installed.
- If the slider is affixed to move the actuator body, also use the slider's tapped holes for installation. (When installing a heavy object, also use pins.)

- Two reamed holes are provided in the slider, so use these holes if position accuracy must be maintained after removal/reinstallation. If the application requires fine-tuning of the squareness, etc., use one of the slider's reamed holes for adjustment.
- Keep the screw-in depth to 20 mm or less.
  If the bolt is screwed in beyond the above dimension, the tip of the bolt may damage the side cover and consequently the actuator.



9. Connecting to the Controller

How to wire the actuator with the controller is explained based on a single-axis configuration.

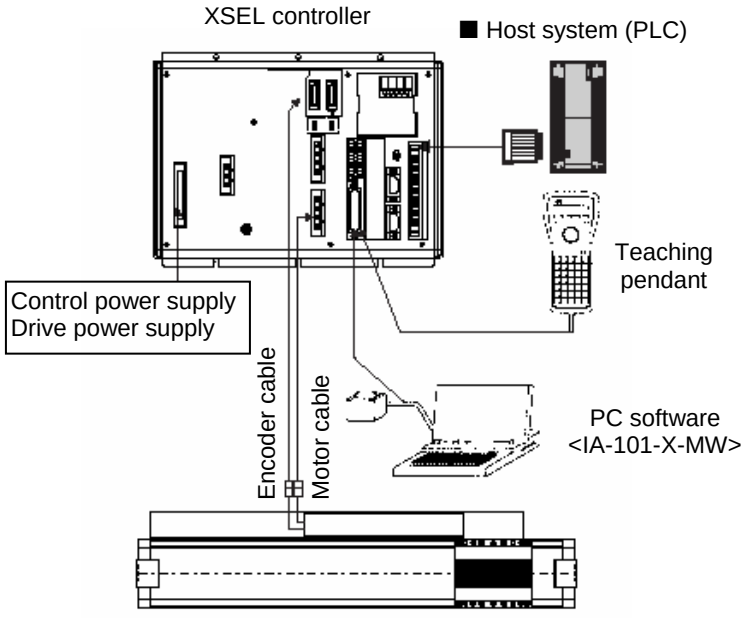
9.1 Wiring an Actuator of Standard Specification [Wiring between the controller and actuator]

If you ordered a single-axis actuator, your actuator should have a 3-meter or 5-meter single-axis cable preassembled with the actuator body. Plug the connector at the end of the cable directly into the connector.
If the actuator is of multi-slider specification, make sure the connectors are joined correctly by referring to the marker tubes (M1, M2, PG1, PG2) at the cable ends.

- Do not extend or shorten the cable by cutting, or reconnect the cable.
- Although the standard cable offers excellent flexibility, it is not a robot cable. Use a robot cable if the cable is to be stored in a moving cable duct (cable bearer, etc.).

If you wish to change the cable specification, contact IAI.

- Connecting to the controller
  An example of connection with a XSEL controller is shown below. The actuator can also be connected to SSEL and SCON controllers.

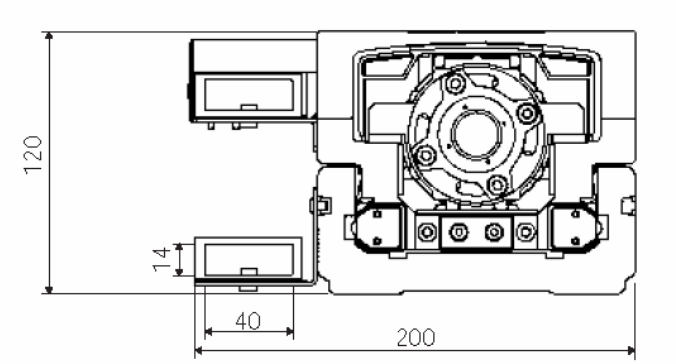


Controller connection cables

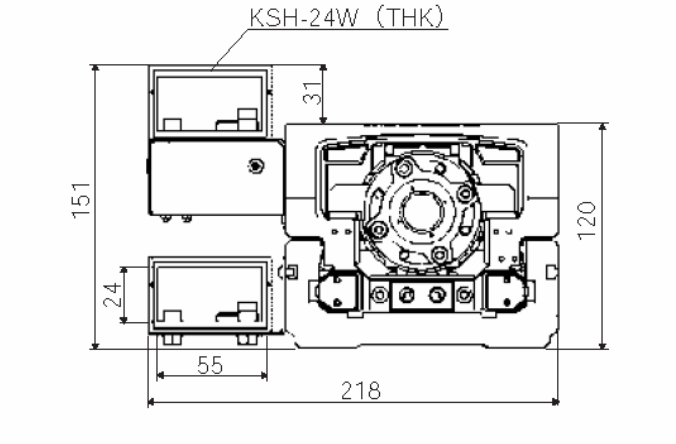
	Motor cable	Encoder cable
Standard	CB-X-MA□□□	CB-X2-PA□□□
With LS/creep sensors	CB-X-MA□□□	CB-X2-PLA□□□

9.2 Cable Bearer

You can choose the standard cable bearer or expanded cable bearer.



Standard cable bearer



Expanded cable bearer (optional)

Take note of the following points when storing cables/hoses in the expanded cable bearer:
[1] Provide a minimum clearance of 2 mm between the outer diameter of the cable/hose bundle and the interior wall of the cable bearer and also between the individual cables and hoses.
[2] The outer diameter of the cable/hose bundle shall not exceed ∅16.8, and the cables/hoses shall be laid side by side, not stacked on top of each other.
If the cables/hoses are stored in the cable bearer without observing the precautions above, an excessive force may be applied to the cables/hoses to significantly shorten the service life of the cables/hoses.

10. Maximum Speed

The maximum speed of this actuator is limited to prevent resonance of the ball screw shaft while conforming to the speed limit of the motor. Take heed of the maximum speed limits specified in the table bellow.

Strokes and maximum speed limits (unit: mm/sec)

Single-slider specification

Type	Capacity (W)	Lead (mm)	Stroke (mm)	Maximum speed (mm/sec)
Horizontal	400	20	500 ~ 1200	1300
		40		2400
Mid-support		20	1300 ~ 3000	1300
		40		2400
Vertical		20	500 ~ 1000	1000

Multi-slider specification

Type	Capacity (W)	Lead (mm)	Stroke (mm)	Maximum speed (mm/sec)
Horizontal	400	20	250 ~ 2250	1300
		40		2400
Vertical	400	20	250 ~ 950	1000

Caution:
- Use each actuator by observing its maximum speed.
- Take note that resonance may still occur at speeds below the applicable limit specified above, depending on the installation condition or operating conditions.
- Resonance of the ball screw shaft may increase the noise level or cause vibration, resulting in a shorter service life of the machine.
- If each actuator is used independently, write a program conforming to the maximum speed of the actuator (refer to the table above). If multiple actuators are used in a synchronized operation, write a program conforming to the lowest of the maximum speeds applicable to all synchronized actuators.
- In either way, always check the maximum speed of each applicable actuator when writing a program.

11. Load Applied to the Actuator

- The load specified in the specification table must not be exceeded.
  In particular, pay attention to the moments applied to the slider, allowable overhang length and loaded mass.
- If the actuator is used as the Y-axis in a cantilever X-Y robot, the base becomes vulnerable to deformation. Accordingly, keep the Ma and Mc moments to one half the rated moment or below. (Refer to the figure below.)

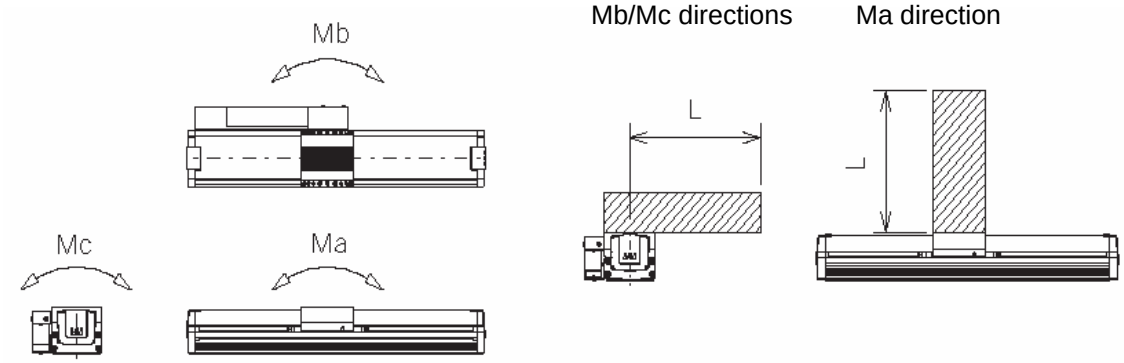
Allowable load moments

Ma	Mb	Mc
104.9 N·m (10.7 kgf·m)	149.9 N·m (15.3 kgf·m)	248.9 N·m (25.4 kgf·m)

Allowable overhang lengths

Ma direction	Mb direction	Mc direction
750 max.	750 max.	750 max.

- The allowable overhang lengths are based on a configuration where the center of gravity of the installed article is positioned at one half the overhang length.



Directions of moment　　Directions of overhang

Application of an excessive load moment may lead to unwanted outcomes such as a shorter service life of the guide. If the overhang length exceeds the allowable value, vibration may occur or the service life of the guide may be negatively affected.

12. Duty

Keep the duty to 50% or below so that the actuator will last for a long time without stopping due to errors.

Duty (%) = Operating time / (Operating time + Stopped time) x 100

If the duty is too high, an overload error and other errors may generate.
If the actuator generated an error, increase the stopped time to lower the duty.

13. Setting the Home

13.1 Operating Principles of Home Return

This actuator implements a home return in the following steps:

[1] Upon receiving a home return command, the actuator determines the moving direction based on the specified parameter.
[2] The actuator detects a home sensor signal during the return operation.
[3] After detecting the home sensor signal, the actuator reverses its direction and operates until a phase Z signal is detected, upon which the actuator defines the applicable position as the reference point.
[4] The actuator travels further by the offset specified by a parameter, and defines the achieved position as the home.

13.2 Fine-tuning the Home Position

The motor revolution after a home sensor signal is detected until a phase Z signal generates has been adjusted prior to shipment.
The table below shows the standard distances from the stopper, reached by the slider when it reverses its direction upon detecting a home sensor signal and eventually stops at the home position.

Lead	Distance from mechanical stopper (mm)
20 mm	5 ± 1
40 mm	5 ± 2

If the direction of home return remains the same, the home position for each actuator can be fine-tuned using the applicable distance shown above by changing the parameter. Follow the steps below to fine-tune the home position:

[1] Perform a home return operation to check the home.
[2] Calculate the difference between the current home position and desired home position, and correct the parameter accordingly.
The value set in the parameter represents an offset in the positive moving direction of the actuator. (The position cannot be corrected in the negative direction.)
[3] Increasing the offset will narrow the moving range of the actuator.
If an offset exceeding 1 mm has been set, also adjust the stroke soft limits.

13.3 Changing the Direction of Home

Should you require changing the direction of home on the actuator after its delivery, contact IAI because the change will require resetting of the moving direction parameter, replacement of sensors and adjustment of encoder phase Z.

⚠ Warning

The encoder not only detects angles of rotation and home signals, but it also serves an important role in the switching of phases in the AC-servo power line. For this reason, the encoder phases have been adjusted precisely. Never touch the encoder to change the home.

14. Maintenance

14.1 Maintenance Schedule

Perform maintenance work according to the schedule below.
The schedule is set assuming eight hours of operation a day. When the operation time is long such as 24-hour operation, shorten the maintenance intervals as needed.

	External visual inspection	Internal inspection	Grease supply	Mid-support wire
Start of operation	○			
After 1 month of operation	○			
Every 3 months		○	○*1	
After 6 months of operation	○	○		
After 1 year of operation	○	○	○	
Every 6 months thereafter	○			
Every year	○	○	○	○*2

*1 Add grease if degradation of grease is observed in the internal inspection.

*2 Carry out the required adjustment if the actuator has a mid-support.

14.2 External Visual Inspection

Check the following items in the external visual inspection.

Body	Loose mounting bolts?
Cables	Damage to cables or connection to connector box?
General	Unusual noise or vibrations?

14.3 Cleaning

- Clean the exterior as needed.
- Wipe off dirt with a soft cloth.
- Do not use strong compressed air on the actuator, as it may force dust into the crevices.
- Do not use petroleum-based solvents, as they may damage resin or coated surfaces.
- If the unit is badly soiled, apply a neutral detergent or alcohol to a soft cloth and wipe lightly.

14.4 Internal Inspection

Turn off the power and remove the screw cover to visually inspect the interior.
Check the following items in the internal inspection.

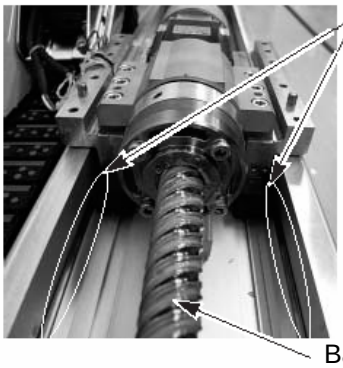
Body	Loose mounting bolts?
Guide	Lubrication condition okay? Soiling?
Ball screw	Lubrication condition okay? Soiling?

Visually check the condition inside the actuator. Specifically, check for entry of dust and other foreign matters and the lubrication condition.
Even if the grease on the guide and ball screw has turned brown, a good lubrication condition is maintained if the traveling surface is wet and glossy.
If the grease has become dirty and is no longer glossy, or when you notice a shortage of grease after a long period of use, clean each area and add grease.
The internal inspection procedure is specified below.

[1] Remove the end cover using an Allen wrench of 1.5 mm across flats.

[2] Remove the screw cover using an Allen wrench of 2.0 mm across flats.

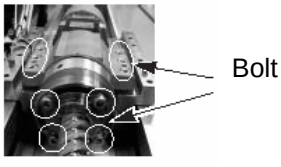
[3] Check the interior.



[4] After the check, assemble the parts by following the same steps in reverse.
When installing the screw cover, make sure the side face bearing the IAI logo is on the same side as the serial number label on the base.

Screw-cover affixing bolt	[M4 x 5] Tightening torque = 0.6 N•m
End-cover affixing bolt	[M3 x 6] Tightening torque = 0.4 N•m

Caution: The hollow-shaft motor has been adjusted at the factory prior to installation. Never loosen the mounting bolts of the hollow-shaft motor.



14.5 Internal Cleaning

- Clean each area using a soft cloth, etc.
- Do not blow compressed air onto the internal parts, as dust may enter through gaps and openings.
- Do not use petroleum solvent, neutral detergent or alcohol.

14.6 Greasing the Guide

14.6.1 Applicable Grease

Lithium grease is used.
The following grease has been applied prior to shipment.

Kyodo Yushi	Daphne Eponex 2

Other manufacturers offer different greases equivalent to the above product. Contact each manufacturer and ask them to suggest equivalent greases corresponding to the product specified above. Examples of equivalent grease products are listed below.

Showa Shell Sekiyu	Albania Grease 2
Mobil Sekiyu	Mobilux 2

⚠ Warning!!

Never use fluorine grease. If fluorine grease is mixed with lithium grease, lithium grease will lose its intended lubrication property and the machine may be damaged.

14.6.2 How to Apply Grease

Two grease nipples are found, one each on the right and left sides of the slider. Apply grease from these nipples.

[1] Using a grease gun, apply grease from the grease nipples located on the end faces of the slider. (Refer to the figure below for the positions of grease nipples.)

Grease nipple positions on the slider

[2] Move the slider back and forth several times by hand.
[3] Repeat the above steps to apply more grease.
[4] Use a waste cloth, etc., to wipe off grease that has overflowed from the slider.

14.7 Greasing the Ball Screw

14.7.1 Applicable Grease

The following lithium grease has been applied prior to shipment.

Kyodo Yushi	Multemp LRL 3

This grease has excellent properties including low heat generation and is suitable for ball screws.
For information on equivalent products (lithium greases), refer to the section on greasing the guide.

⚠ Warning

Never use fluorine grease. If fluorine grease is mixed with lithium grease, lithium grease will lose its intended lubrication property and the machine may be damaged.

14.7.2 How to Apply Grease

Clean the ball screw before applying grease. Apply grease by hand, and then move the slider back and forth to let grease spread evenly. Finally, wipe off excess grease that has overflowed from the nut.

Apply grease on the ball screw.

Move the slider. If the actuator is equipped with a brake, release the brake.

Caution: Adding too much grease may increase the agitation resistance and cause the ball screw to generate heat easily or the excess grease attached to the ball screw may scatter and dirty the surrounding area. Be sure to wipe off excess grease.

14.8 Adjusting the Tension of the Mid-support Wire

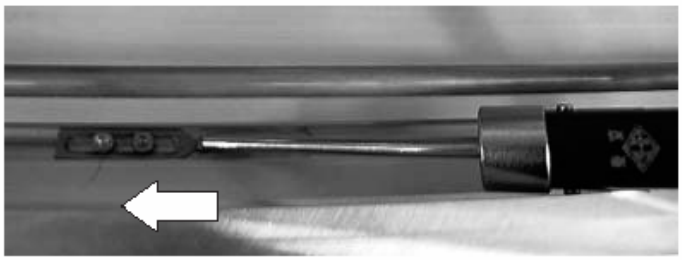
[Items required for adjustment]
- Allen wrenches
- Tension gauge (capable of exerting a push force of at least 1 kg (9,800 N))

[Procedure]
[1] Remove the end cover using an Allen wrench of 1.5 mm across flats.

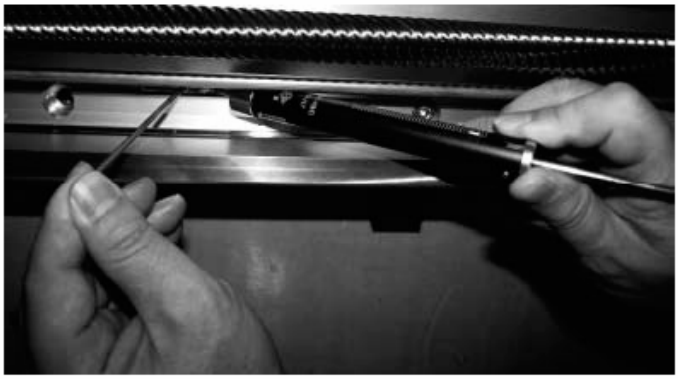
[2] Remove the screw cover using an Allen wrench of 2.0 mm across flats.

[3] Loosen the two screws (M3 x 5) affixing one wire hook (base side) of the mid-support wire located at the center of the base, so that the wire hook can be moved.
Loosen the screws for only one wire hook on either the home side or counter-home side.

[4] Use a tension gauge to push the loosened wire hook with the specified push force, and tighten the two wire hook screws (M3 x 5).



Specified push force: 9,310 to 9,800 N



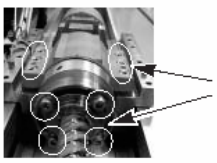
Tighten the screws while pushing the wire hook with the specified push force.

Tightening torque: 1.5 (N•m)

[5] After the check, assemble the parts by following the same steps in reverse.
When installing the screw cover, make sure the side face bearing the IAI logo is on the same side as the serial number label on the base.

Screw-cover affixing bolt	[M4 x 5] Tightening torque = 0.6 N•m
End-cover affixing bolt	[M3 x 6] Tightening torque = 0.4 N•m

Caution: The hollow-shaft motor has been adjusted at the factory prior to installation. Never loosen the mounting bolts of the hollow-shaft motor.



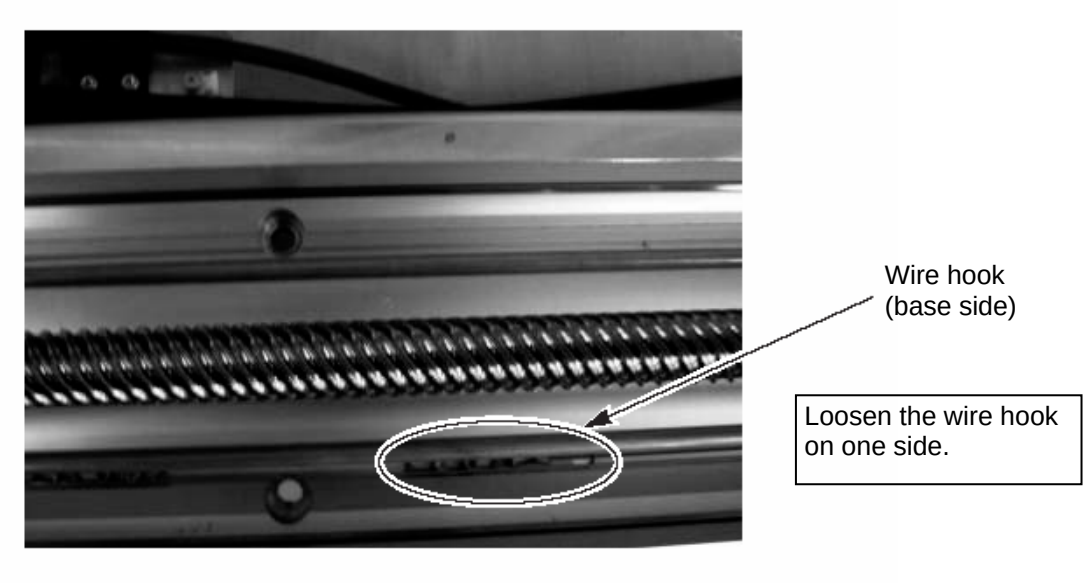
14.9 Replacing the Mid-support Wire

[Items required for adjustment]
- Mid-support wire Model: WR-LXMXS-(stroke)
- Wire hook (base side): As a replacement when the wire catch of the original hook is deformed.
- Wire hook (motor side): As a replacement when the wire catch of the original hook is deformed.
- Allen wrenches
- Tension gauge (capable of exerting a push force of at least 1 kg (9,800 N))

[Procedure]
[1] Remove the end cover using an Allen wrench of 1.5 mm across flats.

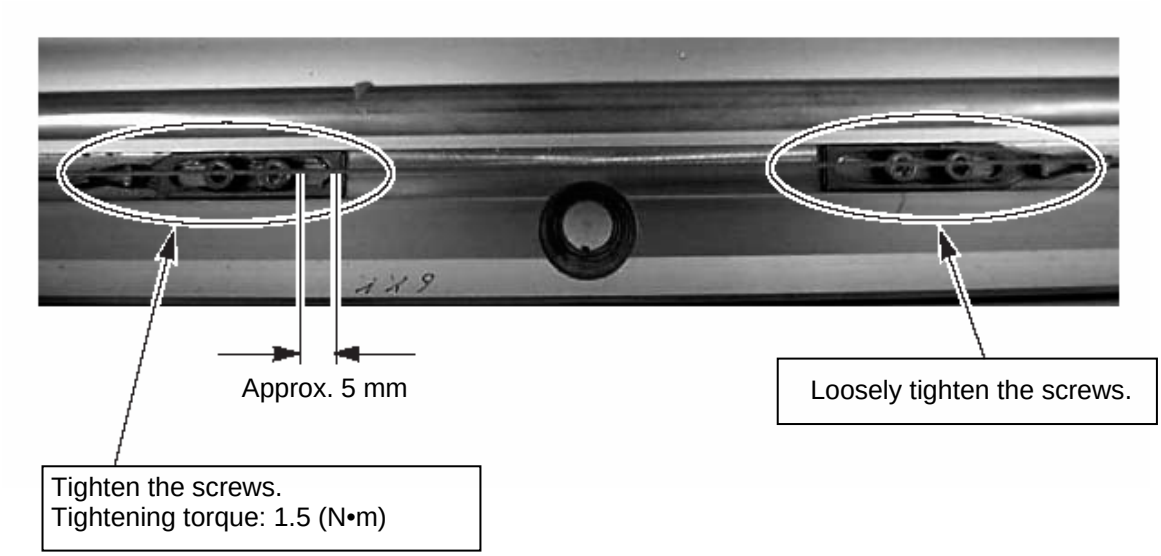
[2] Remove the screw cover using an Allen wrench of 2.0 mm across flats.

[3] Loosen the two screws (M3 x 5) affixing one wire hook (base side) of the mid-support wire located at the center of the base, so that the wire hook can be moved.
Loosen the screws for only one wire hook on either the home side or counter-home side.

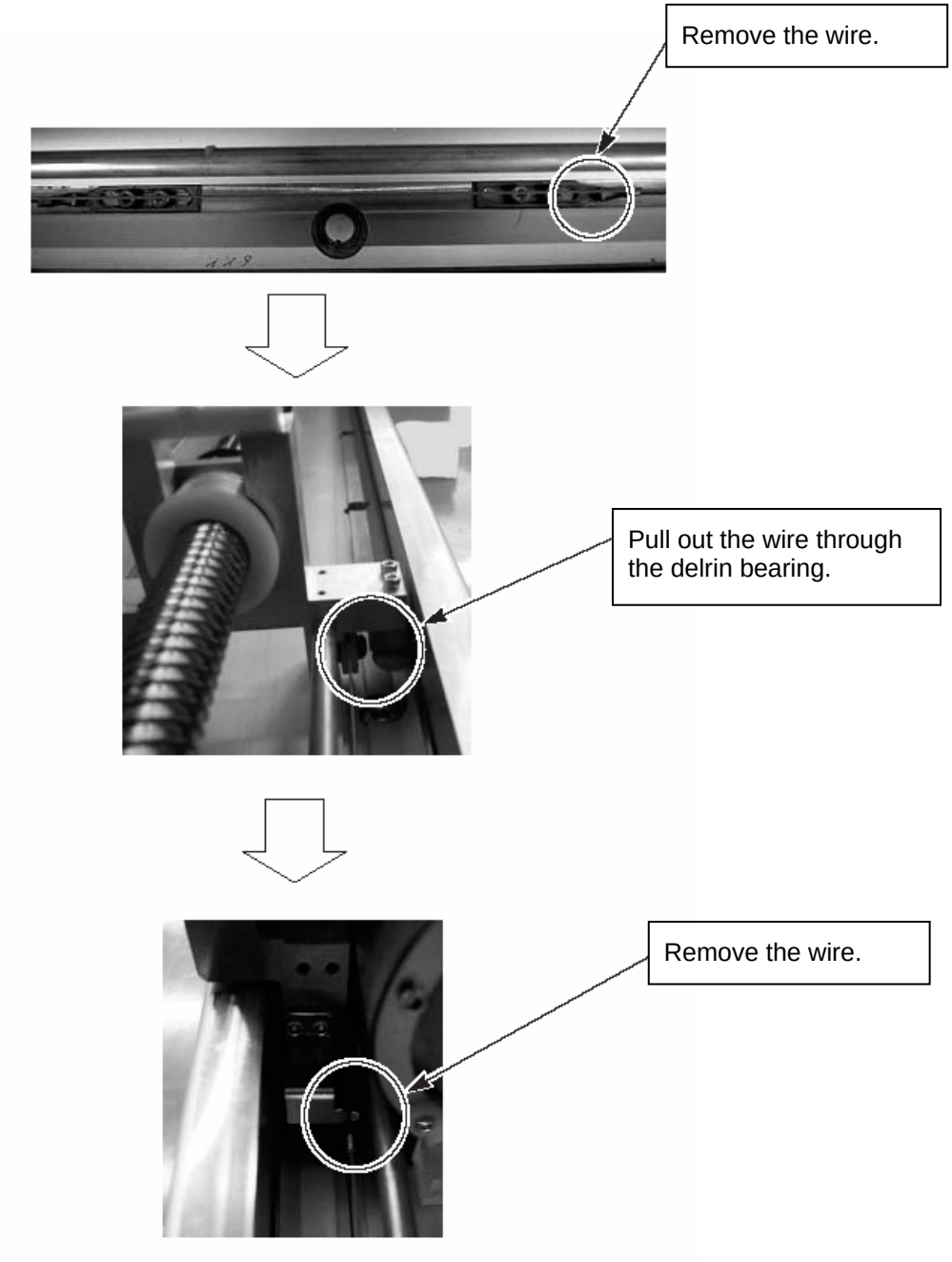


If the wire catch of the hook (base side) is deformed, replace the wire hook as follows:

◎ Replace the wire hook on one side (base side) with a replacement hook, and tighten the two screws (M3 x 5) by keeping approx. 5 mm between the slot end and each screw as shown below. Also replace the wire hook on the other side (base side) with a replacement hook, and loosely tighten the two screws (M3 x 5) so that the wire hook can be moved.

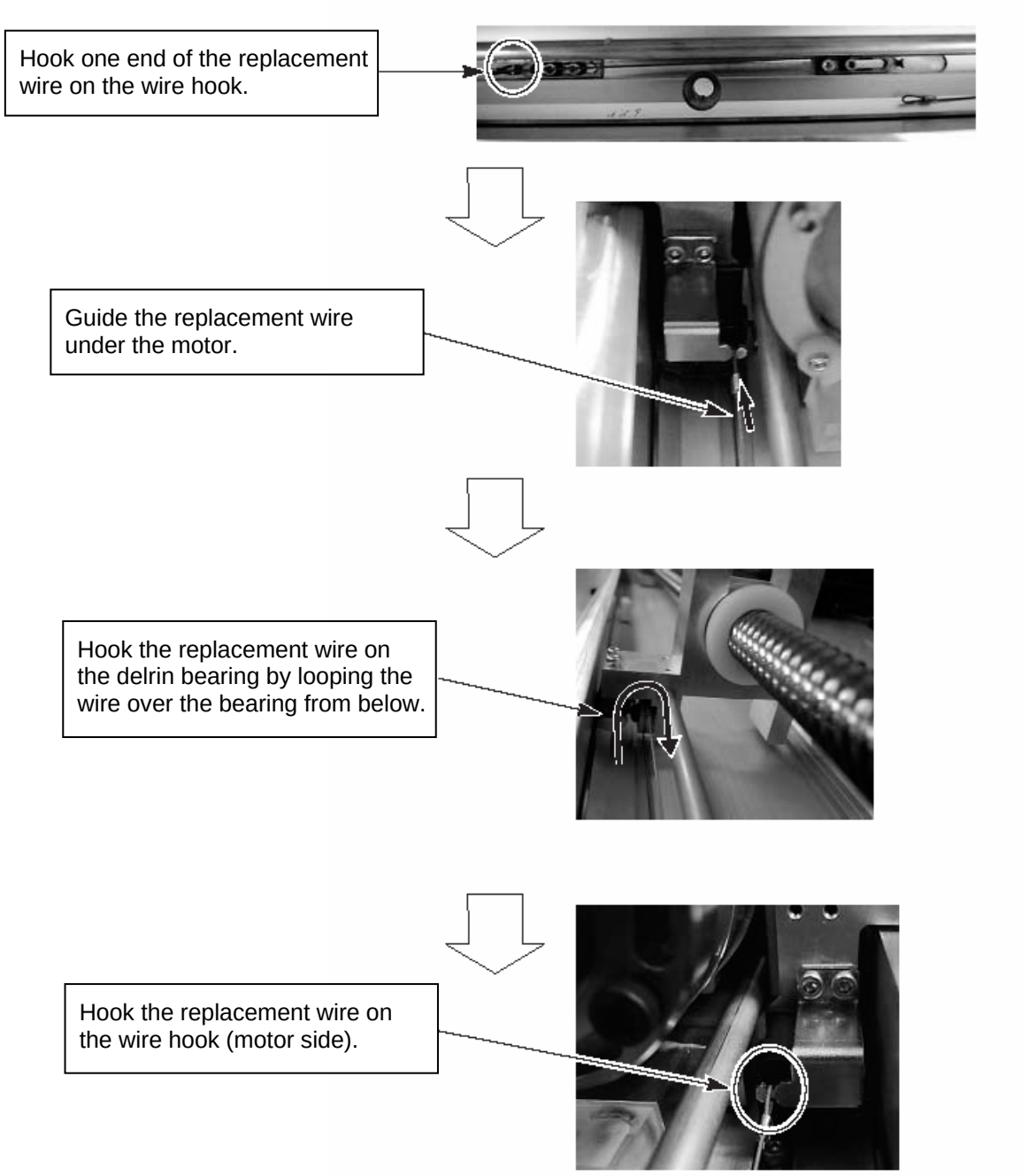


[4] Remove the wire from the wire hook whose screws have been loosened.
Remove the wire from the wire hook (base side). Next, pull out the wire through the delrin bearing at the mid-support and remove it from the wire hook (motor side).



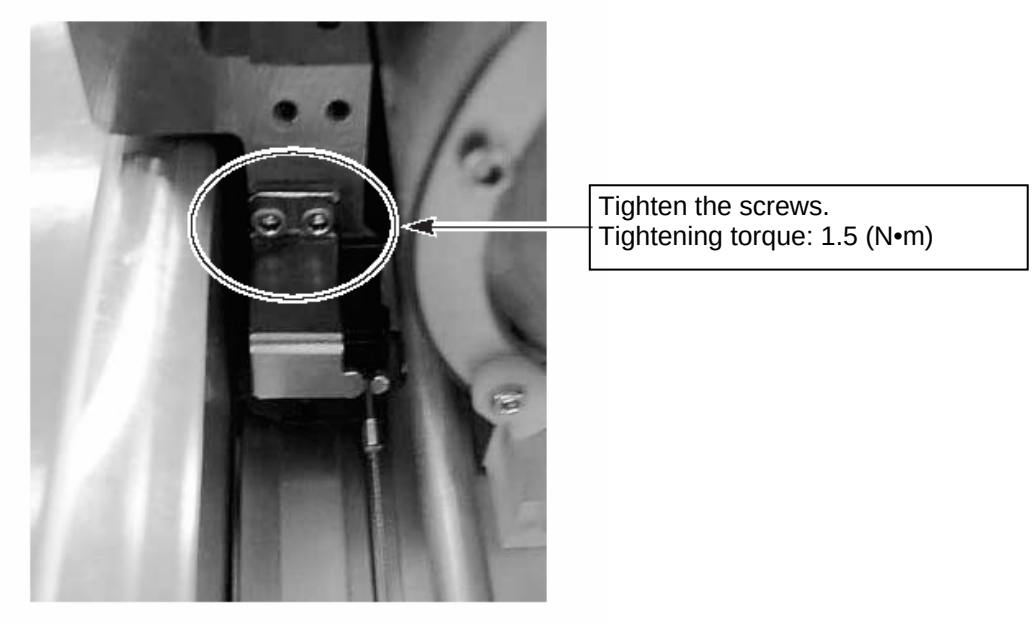
[5] Follow the same steps to also remove the wire from the wire hook (base side) whose screws have not been loosened.

[6] Hook one end of the replacement wire on the wire hook (base side) whose screws have not been loosened. Guide the other end of the wire under the motor and bring it to the mid-support, and hook the wire on the delrin bearing at the mid-support. Next, pull the wire further to the motor and hook it on the wire hook at the motor.


Hook one end of the replacement wire on the wire hook.
Guide the replacement wire under the motor.
Hook the replacement wire on the delrin bearing by looping the wire over the bearing from below.
Hook the replacement wire on the wire hook (motor side).

When hooking the wire in step [6], you may find the wire catch of the hook (motor side) deformed. In this case, replace the wire hook as follows:

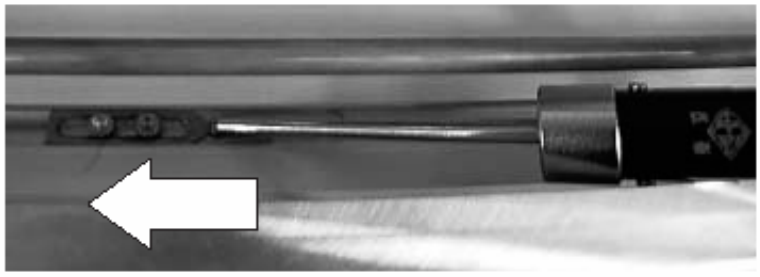
◎ Replace the wire hook with a replacement wire hook (motor side), and tighten the two screws (M3 x 6).



[7] Follow the same steps to also attach the wire to the wire hook (base side) whose screws have been loosened. Specifically, guide the wire from the wire hook (base side) to the delrin bearing at the mid-support, and attach it to the wire hook (motor side).

When hooking the wire in step [7], you may find the wire catch of the hook (motor side) deformed. In this case, replace the wire in the same manner.

[8] Use a tension gauge to push the wire hook (base side) whose screws have been loosened with the specified push force, and tighten the two wire hook screws (M3 x 5).



Specified push force: 9,310 to 9,800 N

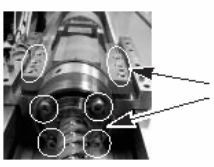
Tighten the screws while pushing the wire hook with the specified push force.

Tightening torque: 1.5 (N•m)

[9] After the check, assemble the parts by following the same steps in reverse.
When installing the screw cover, make sure the side face bearing the IAI logo is on the same side as the serial number label on the base.

Screw-cover affixing bolt	[M4 x 5] Tightening torque = 0.6 N•m
End-cover affixing bolt	[M3 x 6] Tightening torque = 0.4 N•m

Caution: The hollow-shaft motor has been adjusted at the factory prior to installation. Never loosen the mounting bolts of the hollow-shaft motor.

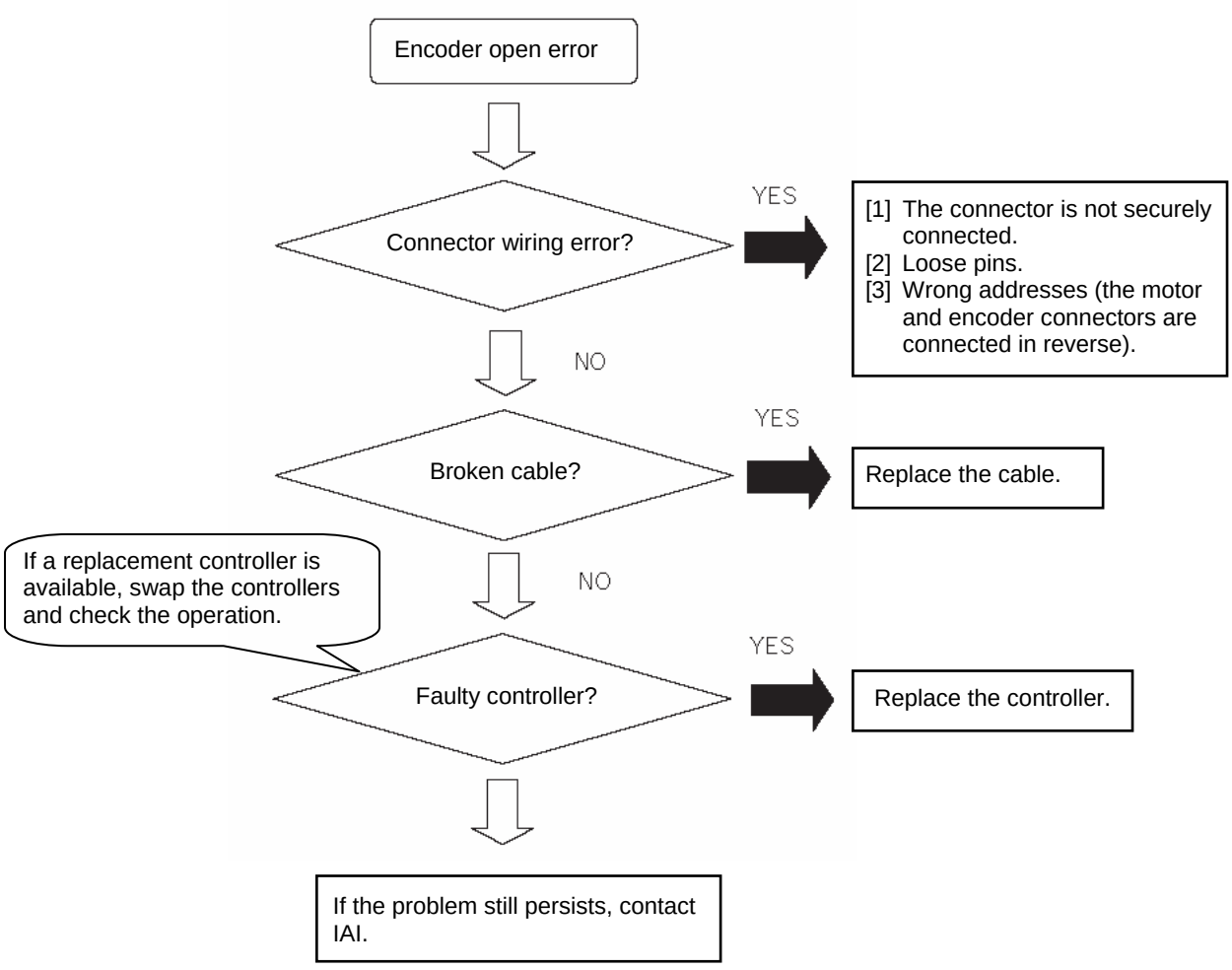


15. Troubleshooting

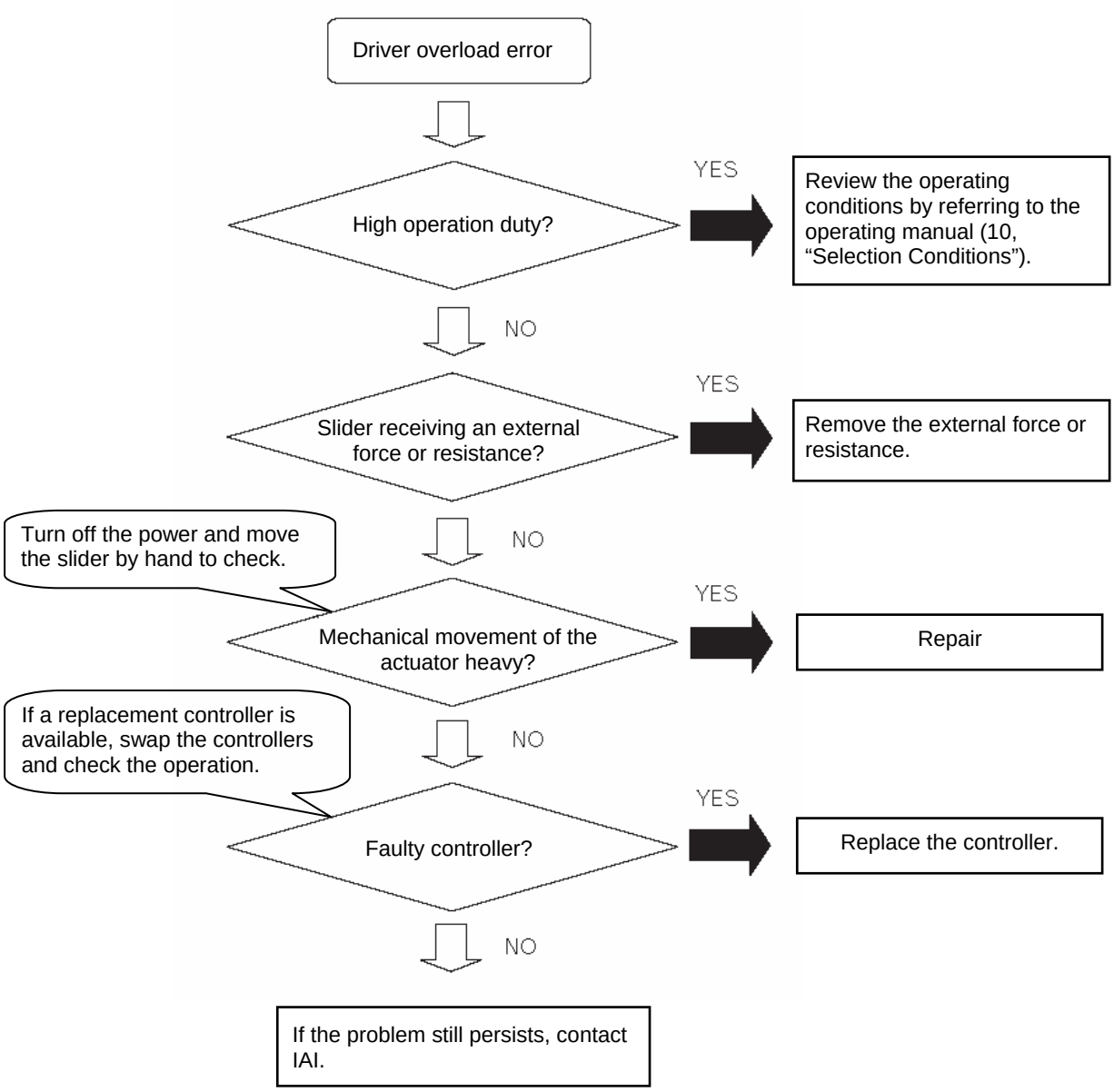
15.1 What to Do When You Suspect a Failure

If an encoder open error, driver overload error, deviation overflow error or any other error occurs, do not hastily determine that the robot or controller is faulty. Refer to the information below and check if the problem can be corrected by the applicable procedure. If the problem still persists after the troubleshooting procedure, contact IAI and provide us with detailed information regarding the problem condition.

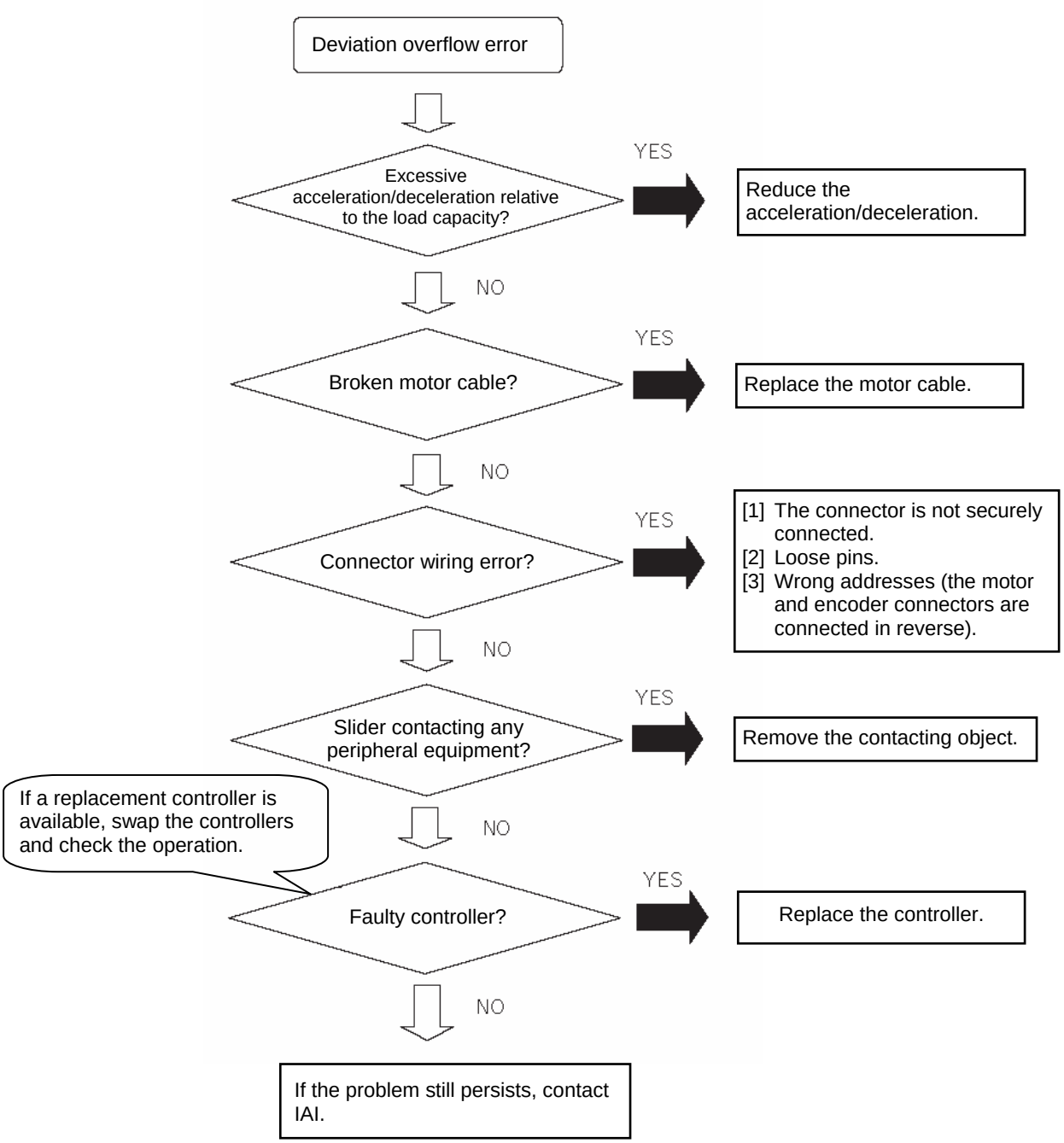
15.2 Encoder Open Error (Error Code: D12)



15.3 Driver Overload Error (Error Code: D0A)


Driver overload error
High operation duty?
YES
Review the operating conditions by referring to the operating manual (10, “Selection Conditions”).
NO
Slider receiving an external force or resistance?
YES
Remove the external force or resistance.
NO
Turn off the power and move the slider by hand to check.
Mechanical movement of the actuator heavy?
YES
Repair
NO
If a replacement controller is available, swap the controllers and check the operation.
Faulty controller?
YES
Replace the controller.
NO
If the problem still persists, contact IAI.

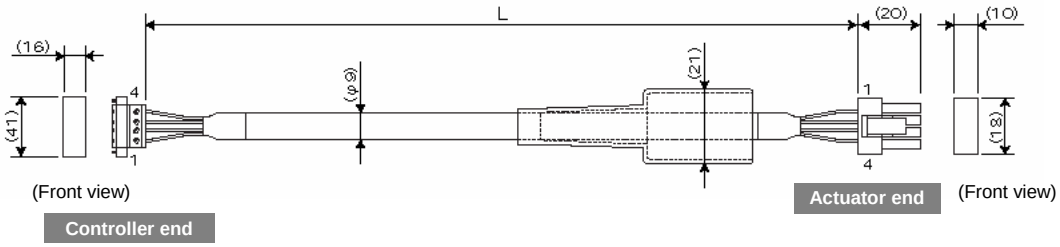
15.4 Deviation Overflow Error (Error Code: C6B)



16. Cable Drawings

[1] Motor cable

Model: CB-X-MA□□□

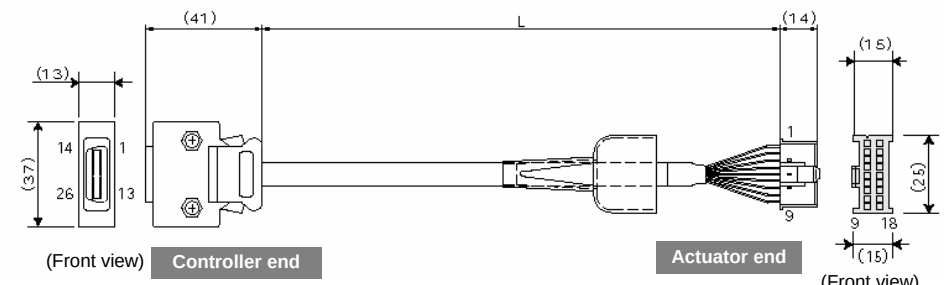


Wire size	Color	Signal	No.
0.75sq	Green	PE	1
	Red	U	2
	White	V	3
	Black	W	4

No.	Signal	Color	Wire size
1	U	Red	0.75sq (crimped)
2	V	White	
3	W	Black	
4	PE	Green	

[2] Encoder cable

Model: CB-X2-PA□□□



Plug housing: XMP-09V (JST)
Socket contact: BXA-001T-P0.6 (JST) x 18
Retainer: XMS-09V (JST)
*6: Use the crimping machine recommended by the connector manufacturer.

Wire size	Color	Signal	No.
AWG26 (soldered)	—	—	10
	—	—	11
	—	E24V	12
	—	OV	13
	—	LS	26
	—	CLEEP	25
	—	OT	24
	—	RSV	23
	—	—	9
	—	—	18
	—	—	19
	—	A+	1
	—	A—	2
	—	B+	3
	—	B—	4
	—	Z+	5
	—	Z—	6
	Orange	SRD+	7
	Green	SRD—	8
	Purple	BAT+	14
	Grey	BAT—	15
	Red	VCC	16
	Black	GND	17
	Blue	BKR—	20
	Yellow	BKR+	21
	—	—	22
Clamp the shield to the hood.			

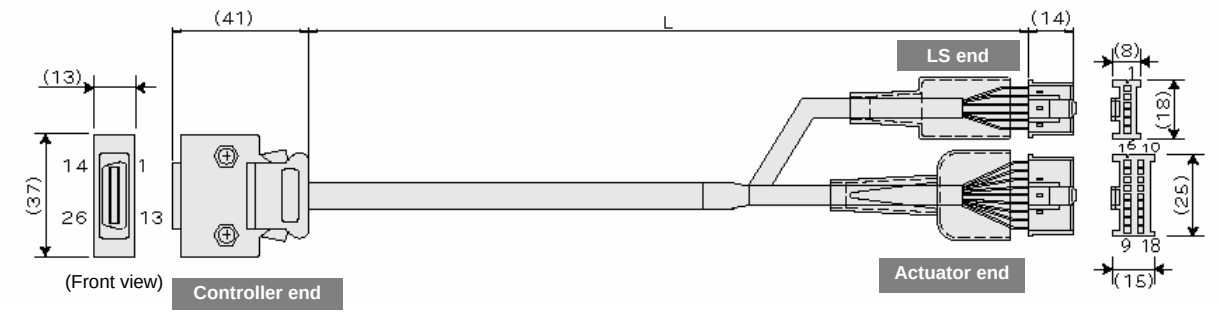
Drain wire or braided shield wire

No.	Signal	Color	Wire size
1	A	White/Blue	AWG26 (crimped)
2	A	White/Yellow	
3	B	White/Red	
4	B	White/Black	
5	Z	White/Purple	
6	Z	White/Gray	
7	—	—	
8	—	—	
9	FG	Drain	
10	SD	Orange	
11	SD	Green	
12	BAT+	Purple	
13	BAT—	Gray	
14	VCC	Red	
15	GND	Black	
16	—	—	
17	BK—	Blue	
18	BK+	Yellow	

("White/blue" in the "Color" field indicates that the cable is white and the insulator is blue.)

[3] Encoder cable with LS

Model: CB-X2-PLA□□□



Wire size	Color	Signal	No.
AWG26 (soldered)	—	—	10
	—	—	11
	White/Orange	E24V	12
	White/Green	0V	13
	Red/Blue	LS	26
	Brown/Yellow	CLEEP	25
	Brown/Red	OT	24
	Brown/Black	RSV	23
	—	—	9
	—	—	18
	—	—	19
	White/Blue	A+	1
	White/Yellow	A−	2
	White/Red	B+	3
	White/Black	B−	4
	White/Purple	Z+	5
	White/Gray	Z−	6
	Orange	SRD+	7
	Green	SRD−	8
	Purple	BAT+	14
	Gray	BAT−	15
	Red	VCC	16
	Black	GND	17
	Blue	BKR−	20
	Yellow	BKR+	21
	—	—	22
Clamp the shield to the hood.			

No.	Signal	Color	Wire size
1	E24V	White/Blue	AWG26 (crimped)
2	0V	White/Yellow	
3	LS	White/Red	
4	CLEEP	White/Black	
5	OT	White/Purple	
6	RSV	White/Gray	

No.	Signal	Color	Wire size
1	A	White/Blue	AWG26 (crimped)
2	A	White/Yellow	
3	B	White/Red	
4	B	White/Black	
5	Z	White/Purple	
6	Z	White/Gray	
7	—	—	
8	—	—	
9	FG	Drain	
10	SD	Orange	
11	SD	Green	
12	BAT+	Purple	
13	BAT−	Gray	
14	VCC	Red	
15	GND	Black	
16	—	—	
17	BK−	Blue	
18	BK+	Yellow	

Drain wire or braided shield wire

("White/blue" in the "Color" field indicates that the cable is white and the insulator is blue.)

MEMO

MEMO

MEMO

Catalog No.: RCS2 Actuator MJ3663-1A-Mar2007-1

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